

OPTIMISATION OF EXPLOSIVE STRENGTH IN BEGINNER FEMALE VOLLEYBALL PLAYERS

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Abstract. Volleyball training for children and juniors should be conducted and guided cautiously, taking into account their physical, functional and mental development characteristics. Physical training plays an important role in the development and use of the athlete's physical qualities with maximum efficiency. It has to serve the priority technical-tactical aspects of the practical activity. In volleyball, the development of explosive strength plays a decisive role as the basis for increasing power, especially since the number of actions performed from jumping (setting, attack, block and serve actions) has increased considerably in the last period. The aim of the research is to identify the effective methods and means to optimise explosive strength in 11-12-year-old female volleyball players. The experimental study took place between 8 June 2015 and 6 June 2016 on a sample of 25 female athletes from the Volleyball section of the "Mircea Eliade" Club in Bucharest. To assess explosive strength, we used two tests employed by the Romanian Volleyball Federation, namely "One-hand approach jump" and "Triple approach jump and landing on two feet". The operational programme of the means introduced in the training plan of the athletes mainly included means of athletics, as well as means using the hurdles, ropes, coordination ladder, Bosu device and the multiple combinations between them. The results obtained in the final test revealed the effectiveness of the programmes included in the training of athletes, in the sense of increased explosive strength.

Keywords: explosive strength, atypical means, female beginners, volleyball.

Introduction

Explosive strength is the main ingredient of all sports where the degree of production and especially the use of strength, speed and agility is high (Bompa & Carrera, 2006, p. 178).

This is defined as the ability of the neuromuscular system to develop in the shortest possible time an amount of strength able to overcome a resistance based on rapid voluntary muscle contraction (Rață & Rață, 2006, p. 55).

Volleyball is a sport characterised by short-duration actions performed over an extended period of time, in which the manifestation of explosive strength-endurance occurs under intermittent conditions (Hespanhol, Neto, de Arruda, & Dini, 2007).

Explosive strength is one of the most important qualities a volleyball player needs to have and develop, most of the technical tactical actions being made by jumping (strike/attack hit, block, setting, and serve hit). The higher the jump in the block, the more the potential to reduce the effectiveness of the adverse attack increases; in the attack hit, the higher the jump, the higher the point of contact with the ball, and the possibilities to orient the ball to different angles are more numerous (Riggs & Sheppard, 2009). In the setting, we can say that these actions executed from jumping offer the possibility of a combinative game with multiple opportunities of completing the offensive phase and having an unpredictable game; during the serve hit, the execution from jumping is done with higher indices of strength and speed.

The development of explosive leg strength is a sine qua non condition in determining the level of performance in volleyball (Graur & Făgăraș, 2013); therefore, we consider that this should be dealt with as a priority for beginners.

Problem statement

The issue of approaching explosive strength in general and particularly in volleyball is a rather well-researched segment in the literature (Kozina et al., 2019; Lidor & Ziv, 2010; Pricop, Leonte, & Popescu, 2017), whether it is addressed from the perspective of investigation, development/optimisation or comparison between the members of different teams, between different playing areas or it is investigated in the field of university sport.

Many studies on the explosive strength of children and juniors aged 10-12 years have been conducted for other sports disciplines such as athletics, rhythmic gymnastics or alpine skiing (Branet, 2017; Netolitzchi, Grigoroiu, Pelin, & Pricop, 2015; Răchită & Wesselly, 2015), but regarding volleyball, we find very few in the literature about its development at beginner level. Several studies in the field address older ages, 16-17, where most programmes use the development of maximum strength (which is not allowed in younger ages) as the basis for

developing explosive strength by introducing alternate contract schemes in the training of volleyball players (Crețu & Vladu, 2010) or by using sand drills to increase explosive strength in the lower body (Rajkumar & Devarishi, 2013).

The novelty of this paper consisted in approaching the optimisation of explosive strength by introducing into training means borrowed from athletics and aerobic gymnastics, as well as several means executed with different materials such as the coordination ladder and Bosu hemisphere, which allowed us to increase the take-off efficiency blocking the trunk in a balanced position during flight and landing in the spot of take-off.

Purpose of the study

The purpose of the paper is to improve explosive strength in beginner female volleyball players aged 11-12 years by designing and implementing in the training lessons some operational structures borrowed from athletics and artistic gymnastics, as well as means executed with the help of hurdles, ropes, coordination ladder, Bosu hemisphere and the multiple combinations between them.

Material and methods

Subjects, place and strategy of the research

The pedagogical experiment that included a group of 25 female athletes aged between 10-12 years from the Volleyball section of the “Mircea Eliade” Club in Bucharest was based on the stages shown in Table 1.

Table 1. *Duration and stages of the experiment*

Period	Activity performed
19.06.2017 - 25.06.2017	Initial test
24.07.2017 – 27.05.2018	Implementation of the training programmes
28.05.2018 - 29.05.2018	Final test

In 2017-2018, after previously applying a 4-week programme of strength and anatomical adaptation, the experimental group performed 35 hours and 17 minutes of combined means (ladder, hurdles, Bosu device, rope), 12 hours and 40 hours minutes of means specific to athletics and 7 hours and 10 minutes of means specific to artistic gymnastics in order to develop explosive strength. Both the low-impact plyometric method and the method of alternating isometric dynamic and dynamic explosive contractions were used. Only the weight of one’s own body was used as a load. The adaptation and application of the means took place according to the training period, the training level and the needs of each female athlete. We exemplify in Table 2 sequences from the content of a motor programme experimented by us.

Didactic strategy

Materials: hurdles, Bosu device, ropes, poles

Methods: demonstration, explanation, practice, conversation

Table 2. *Example of means for explosive strength*

Means	Variants and Dosing
Athletics	
a.1 Step up executed at 3-5 running steps	a.1 3 x 30 m on each leg
a.2 Running on the spot with the knees up followed by approach jump and landing on two legs and speed run over 6-7 m with 40-m run	a.2 simple/with rope 3 x 10 executions + 40 m
a.3 Triple jump followed by 10-m speed run	
Artistic Gymnastics	
g.1 jump with 180-degree turn	a.3 4-6 series g.1 to the right, to the left 3 x 6 reps followed

g.2 jump with trunk extension	by face, back, lateral movement 4 x 6 reps each g.2 4 x 10-12 reps
Bosu Semi-sphere	
b.1 holding the squat position	b.1 simple, preceded by jump, by turn jump 4 x 10 executions each
b.2 turn jump	b.2 180, 360 degrees, to the right, to the left 4 x 8 executions
b.3 getting off jumping and coming down on the device	b.3 on a leg, on both, with the rope 4 x 12 executions
Hurdles	
h.1 lateral jumps followed by speed running	h.1 4 x 14 reps + 10 m speed
h.2 forth-back jumps	h.2 on one leg, on two, followed by face, lateral movement 4 x 10 reps + 5-7 m
h.3 jumps	h.3 knees up followed by triple jump, jumping on one leg, lateral jumping 2 x 10 + 10 reps
Coordination ladder	
l.1 approach attack steps	l.1- 2 ladder lengths
l.2 jumping and landing on the same stair of the ladder	l.2- 3 ladder lengths
l.3 movements along the ladder	l.3- 2 lengths preceded by jumps interleaved with hurdles, with simple/on-the-ladder jump
Standing on the right of the ladder	
T1 – lateral step with the left leg in the centre of the ladder	
T2 – closing the right leg	
T.3 – lateral step with the left leg outside the ladder	
T4 – step forward with the right leg in the centre of the ladder	

Research techniques used

The research instruments were represented by the following tests used by the Romanian Volleyball Federation:

- one-hand approach jump
- triple approach jump and landing on two feet

The second test was used to make sure that explosive strength has developed. Progress might be due to the learning of take-off and maintaining the trunk in a balanced position during the flight rather than the development of explosive strength.

Research design

The research methods used to develop the pedagogical experiment are the following: bibliographic documentation, direct and indirect observation, experiment, testing and measurement, statistical method and graphical method (Epuran, 2005).

Results

We present below the initial and final results of the experimental group based on the determined statistical indicators: arithmetic mean (Avg), standard deviation (St. dev.), difference between arithmetic means (Diff), coefficient of variation (Cv) and Student's t-test. Analysis of the results obtained at the end of the experiment, after statistical calculations (Table 3), indicates the following:

Table 3. *Initial and final results*

Test	Avg	St. dev.	Diff	Cv%	t	p
Vertical Jump	I 2.35	0.099	0.9	3.82	4.09	0.001
	F 2.44	0.067		2.74		
Long Jump	I 4.85	0.43	0.33	8.99%	3.29	0.001
	F 5.41	0.27		5.22%		

The values of the one-hand approach jump were measured for 25 students in the two initial and final tests. The arithmetic means obtained were 2.35 m and 2.44 m, respectively. We notice that the mean in the final test has increased by 0.09 m. For the one-hand approach jump, the calculated values of the standard deviation and the coefficient of variation show that the sample is homogeneous in the initial test, as well as in the final test. The verification of the statistical hypothesis performed using the bilateral dependent t-test reveals a statistically significant difference between the means, $p = 0.0001$ being lower than 0.05. The graphical representation confirms these statements (Figure 1a).

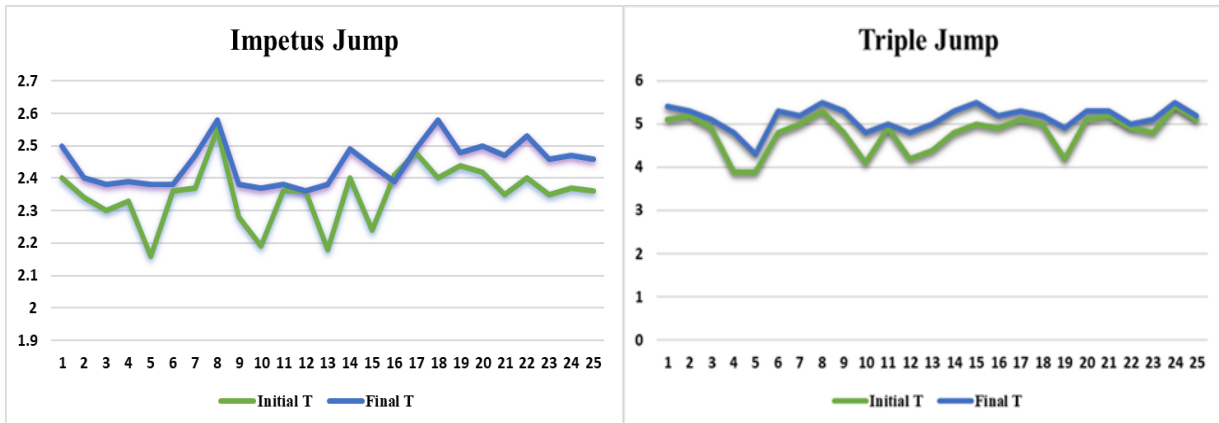


Figure 1. Representation of the results obtained by the experimental group in the initial test vs. the final test (a) Approach Jump, (b) Triple Jump

The values of the triple jump with landing on two feet were measured for 25 students in the initial and final tests. The arithmetic means obtained were 5.14 and 4.80 m, respectively. We notice that the mean in the final test has increased by 0.33 m. For the triple jump, the calculated values of the standard deviation and the coefficient of variation show that the sample is homogeneous in the initial test, as well as in the final test. The verification of the statistical hypothesis performed using the bilateral dependent t-test reveals a statistically significant difference between the means, $p = 0.0001$ being lower than 0.05. The graphical representation confirms these statements (Figure 1b).

Conclusion

The analysis and interpretation of experimental results reveals that beginner female players have made real progress in the development of explosive strength. The approach jump has improved by 9 cm on average, and the triple jump with landing on feet has improved by 30 cm.

The proposed programme for the improvement of explosive strength proved to be appropriate for the beginner female volleyball players, the differences between the two tests being statistically significant.

The training lessons exploring explosive strength had positive feedback from the beginner female volleyball players, the means included in the programme being various and captivating them. The methodology of developing explosive strength has always taken into account the physical, functional and psychological particularities of the development of volleyball players aged the 11-12 years. The state of health and reducing the risk of injury were a priority during the training lessons.

Authors' Contribution

All authors contributed equally to this study and should be considered as main authors.

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